Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.)

Statute No. 9, Faculty Board of Studies, Section-15 (3)

For M.Sc. (Ag.) Soil Science Course
Session 2022-23
Minutes of the Meeting

A meeting of Board of Studies for M.Sc.(Ag) Soil Science was conducted on dated 14.10.2022 at 2.00 P.M. in the Faculty of Agriculture. The following respected members were presented in the same.

S.N.	Name of the Members	Designation & Address	Committee position	Signature
1.	Dr. D.P: Rai	Dean	Chairman	
2.	Dr. Janardan Yadav	Prof. Soil Science Deptt. of Soil Science & Ag. Chemistry Institute of Agricultural Sciences BHU Varanasi (UP)	External Expert	
3.	Dr. K.K. Singh	Prof. & Head, Deptt. of Transfer Technology	Member	
4.	Dr. S.P. Mishra	Head Deptt. of Crop Science	Member	14/10/22
5.	Dr. Kusum Singh	DR(Academy)	Member	
6.	Dr. Lalit Singh	DR (Examination)	Member	
7.	Dr.Harishanker Kushwaha	Prof. Agronomy Deptt. of NRM	Member	14/10/2022
8.	Dr. S.S. Gautam	Associate Prof. (Agril. Statistics)	Member	
9.	Dr. Y.K. Singh	Associate Prof. Deptt. of Transfer Technology	Member	
10.	Dr S.S. Singh	Assistant Prof. Deptt. of Crop Science	Member	
11.	Dr. U.S. Mishra	Associate Prof. Deptt. of NRM	Member	14/10/22
12.	Dr. Pawan Sirothia	Head, Department of NRM	Member Secretary	

1. All the Committee Members discussed on the name of course and suggested that, the name of Degree should be M.Sc. (Ag.) Soil Science as per the ICAR has revised and restructured Post-graduate on the basis of National Education Policy-2020 as per the ICAR accreditation committee report.

2. The Committee Members discussed thoroughly on the course contents and semester wise breakup of the course. The valuable advice of the members were incorporated in the light of course breakup as per prescribed by the ICAR has revised and restructured Post-graduate to finalize the syllabus of M.Sc. (Ag.) Soil Science course.

3. Course will be effective from Academic Session 2022-23.

The meeting ended with a vote of thanks to the esteemed external members, faculty members and the chair.

M.Sc. (Ag.) Soil Science

Semester wise course distribution

Semester – I				
S.L.	**Course**	**Name of the course**	**Code**	**Credit**
1.	Major course	Soil Mineralogy, Genesis, & classification	SOIL-504	2+1=03
2.	Major Course	Soil Survey And Land Use Planning	SOIL-513	2+0=02
3.	Minor Course	Agronomy of Major Cereals and Pluses	AGRON- 506	2+0=02
4.	Supporting course	Statistical Methods For Applied Science	STAT- 502	3+1=04
5.	Common course	Technical Writing And Commutation Skills	COMMON COURSE/PGS-502	0+1=1
6.	Common course	Basic Concept in Laboratory Techniques	COMMON COURSE/PGS-504	0+1=1
		Total Credit-		**9+4=13**
		Semester – II		
1.	Major course	Soil Physics	SOIL-501	2+1=03
2.	Major course	Soil fertility & Fertilizer use	SOIL-502	2+1=03
3.	Minor course	Principle and Practices of Water Management	AGRON-504	2+1=03
4.	Supporting course	Experimental Design	STAT- 511	2+1=03
5.	Common Course	Library & Information Services	COMMON COURSE/PGS-501	0+1=01
6.	Common Course	Intellectual Property Write and its Management in Agricultural	COMMON COURSE/PGS-503	1+0=01
		Total Credit-		**9+5=14**
		Semester – III		
1.	Major course	Soil Chemistry	SOIL-503	2+1=03
2.	Major Course	Soil Erosion & Conservation	SOIL-505	2+1=03
3.	Major course	Seminar	SOIL- 591	0+1=01
4.	Minor course	Principles and Practice of Organic Farming	AGRON-513	2+1=03
5.	Common Course	Agricultural Research. Research Ethics and Rural Development Programme	COMMON COURSE/PGS-505	1+0=01

6.	Major course	Masters Research	SOIL- 599	0+15=15
		Total Credit-		**7+19=26**
		Semester – IV		
1.	Major course	Analytical Techniques and Instrumental Methods in Soil & Plant Analysis	SOIL-510	2+0=02
2	Major course	Land Degradation & Restoration	SOIL- 512	1+0=01
2.	Major course	Masters Research	SOIL-599	0+15=15
		Total Credit-		**3+15=18**
		I, II, III, & IV Semester Total Credit -		**71**

Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.)

Faculty of Agriculture

Department of Natural Resource Management

1.	Session	2022-23
2.	Degree	M.Sc. (Ag.) Soil Science
3.	Intake	05 student in each year or as per ICAR and university direction.
4.	System of education	Credit system (Semester Basis)
5.	Eligibility	B.Sc. (Ag.)
6.	Mode of Admission	Through Entrance Test
7.	Duration of course	4 Semester (Two Years)
8.	Total Credit	71
9.	Grading	10 Point Scale
10.	Examination & Evaluation	As per university Credit System Regulation
11.	Fee	As per university norms

I[st] Semester

SOIL- 504 Soil Mineralogy, Genesis, Classification and Survey (2+1) = 03

Course Title : **Soil Mineralogy, Genesis and Classification**
Course Code : **Soil 504**
Credit Hours : **2+1**

Aim of the course

To acquaint students with basic structure of alumina-silicate minerals and genesis of clay minerals; soil genesis interims of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning.

Theory

Unit I

Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism.

Unit II

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystal line and non-crystal line clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils, role of clay minerals in plant nutrition, interaction of clay with humus, pesticides and heavy metals.

Unit III

Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils.

Unit IV

Concept of soil individual; soil classification systems – historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

Practical

Separation of sand, silt and clay fraction from soil
Determination of specific surface area and CEC of clay
Identification and quantification of minerals in soil fractions
Morphological properties of soil profile in different land forms
Classification of soils using soil taxonomy
Calculation of weathering indices and its application in soil formation
Grouping soil susing available database in terms of soil quality

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil taxonomy and genesis and and their utility in research for solving field problem.

Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu. Buol EW, Hole ED, MacCracken RJ and Southard RJ. 1997. *Soil Genesis and Classification*. 4th Ed. Panima Publ.

Dixon JB and Weed SB. 1989. *Minerals in Soil Environments*. 2nd Ed. Soil Science Society of America, Madison.

Grim RE. 1968. *Clay Mineralogy*. McGraw Hill.

Indian Society of Soil Science 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.

Sehgal J. 2002. *Introductory Pedology: Concepts and Applications*. New Delhi

Sehgal J. 2002. *Pedology - Concepts and Applications*. Kalyani.

USDA. 1999. *Soil Taxonomy*. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.

Wade FA and Mattox RB. 1960. *Elements of Crystallography and Mineralogy*. Oxford & IBH.

Wilding LP and Smeck NE. 1983. *Pedogenesis and Soil Taxonomy*: II. *The Soil Orders*. Elsevier.

Wilding NE and Holl GF. (Eds.). 1983. *Pedogenesis and Soil Taxonomy*.

SOIL- 513 Soil Survey and Land Use Planning (2+1) = 03

Course Title : Soil Survey and Land Use Planning
Course Code : Soil 513
Credit Hours : 2+0

Aim of the course

To teach the better utilization of land for agricultural purposes, and better management of run-off or surplus/ excessive rain-water in the catchment area for agricultural purposes in a watershed.

Theory

Unit I

Soil survey and its types; soil survey techniques- conventional and modern; soil series–characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; thematic soil maps, cartography, mapping units, techniques for gene ration of soil maps, application of remote sensing and GIS in soil survey and mapping of major soil group of India

Unit II

Landform–soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT)–concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

Unit III

Concept and techniques of land use planning; factors governing present land use; Land evaluation method sand soil-site suitability evaluation for different crops; land capability classification and constraints in application.

Unit IV

Agro-ecological regions/sub-regions of India and their characteristics in relation to crop production. Status of LUP in India.

Practical

Aerial photo and satellite data interpretation for soil and land use

Cartographic techniques for preparation of base maps and thematic maps, processing of field sheets, compilation and obstruction of maps in differentscales

Land use planning exercises using conventional and RS tools

Teaching methods/activities

Classroom teaching with AV aids, group discussion, field visit and exposure visit

Planning for land use in proper way for higher crop productivity.

Suggested Reading

Boul SW, Hole ED, MacCraken RJ and Southard RJ. 1997. *Soil Genesis and*

AGRON- 506 Agronomy of Major Cereals (2+0) = 02

Course Title : **Agronomy of Major Cereals and Pulses**
Course Code : **Agron 506**
Credit Hours : **2+0**

I Aim of the course

To impart knowledge of crop husbandry of cereals and pulse crops.

I Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of:

Unit I: *Rabi* cereals.
Unit II: *Kharif* cereals.
Unit III: *Rabi* pulses
Unit IV: *Kharif* pulses.

VI. Practical

Phonological studies at different growth stages of crop
Estimation of crop yield on the basis of yield attributes
Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
Working out growth indices (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
Estimation of protein content in pulses
Planning and layout of field experiments
Judging of physiological maturity in different crops
Intercultural operations in different crops
Determination of cost of cultivation of different crops
Working out harvest index of various crops
Study of seed production techniques in selected crops
Visit of field experiments on cultural, fertilizer, weed control and water management aspects
Visit to nearby villages for identification of constraints in crop production

VIII Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

VI Learning outcome

Basic knowledge on cereals and pulse growing in the country .

VII Resources

Das NR. 2007. *Introduction to Crops of India.* Scientific Publ.

Hunsigi G and Krishna KR. 1998. *Science of Field Crop Production.* Oxford & IBH.

Jeswani LM and Baldev B. 1997. *Advances in Pulse Production Technology.*ICAR.

Khare D and Bhale MS. 2000. *Seed Technology.* Scientific Publ.

Kumar Ranjeet and Singh NP. 2003. *Maize Production in India: Golden Grain in Transition.*IARI, New Delhi.

STAT- 502 Statistical Methods for Applied Sciences 4(3+1)

I. **Course Title** : **Statistical Methods for Applied Sciences**

II. **Course Code** : **STAT 502**

III. **Credit Hours** : **3+1**

IV. **Aim of the course**

This course is meant for students who do not have sufficient background of Statistical

Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

V. **Theory**

Unit I

Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation.

Unit II

Discrete and continuous probability distributions, Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

Unit III

Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of

determination, Fitting of quadratic models.

Unit IV

Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the randomness of a sequence. Median test.

Unit V

Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

VI. **Practical**

- Exploratory data analysis, fitting of distributions ~ Binomial, Poisson, NegativeBinomial, Normal.
- Large sample tests, testing of hypothesis based on exact sampling distributions ~chi square, t and F.
- Confidence interval estimation and Correlation and regression analysis, fitting ofLinear and Quadratic Model.
- Non-parametric tests. ANOVA: One way, Two Way, SRS.

VII. **Suggested Reading**

- Goon A.M, Gupta M.K and Dasgupta B. 1977. *An Outline of Statistical Theory*. Vol. I. The World Press.
- Goon A.M, Gupta M.K. and Dasgupta B. 1983. *Fundamentals of Statistics*. Vol. I. The World Press.
- Hoel P.G. 1971. *Introduction to Mathematical Statistics*. John Wiley.
- Hogg R.V and Craig T.T. 1978. *Introduction to Mathematical Statistics*.

PGS 502: Technical Writing and Communications Skill 1(0+1)

Objective To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well aswriting).

Practical

Technical Writing Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (titlepage, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);

Error analysis (Common errors); Concord; Collocation; Phonetic symbolsand transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

English Dictionary. 1995. Harper Collins. Gordon HM & Walter JA. 1970.
Technical Writing. 3rd Ed. Holt, Rinehart & Winston. Hornby AS. 2000. Comp.
James HS. 1994. Handbook for Technical Writing. NTC
Mohan K. 2005. Speaking English Effectively.
High School English Grammar and Composition. S. Chand & Co.

PGS 504: Basic Concepts in Laboratory Techniques **1(0+1)**

Objective:

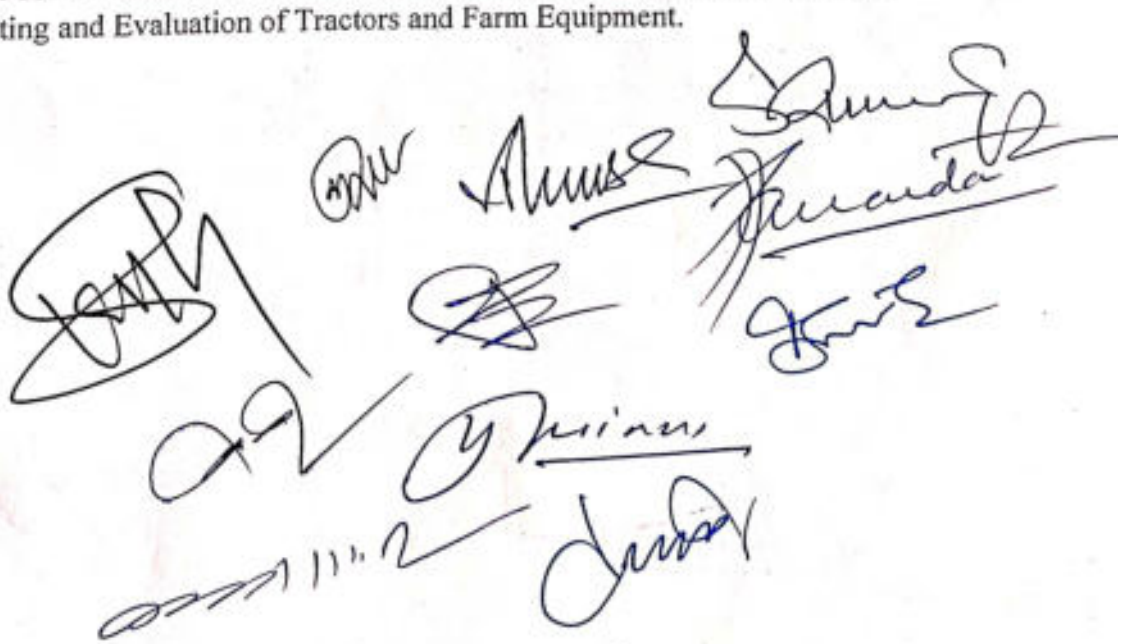
To acquaint the students about the basics of commonly used techniques in laboratory.
Practical:

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of differentstrengths

and their dilution; Handling techniques of solutions; Preparation of different agrochemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relationto taxonomy

Suggested Readings

Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press. Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8.
FMPE 503: Testing and Evaluation of Tractors and Farm Equipment.



II[nd] Semester

SOIL-501 Soil Physics (2+1) = 03

Theory

Course Title : Soil Physics
Course Code : Soil 501
Credit Hours : 2+1

Aim of the course

To impart basic knowledge about soil physical properties and processes in relation to plant growth.

Theory

Unit I

Basic principles of physics applied to soils, soil as a three phase system.

Unit II

Soil texture, textural classes, mechanical analysis, specific surface.

Unit III

Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts. Alleviation of soil physical constraints for crop production. Soil erosion and edibility

Unit IV

Soil structure - genesis, types, characterization and management soil structure;soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation.

Unit V

Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

Unit VI

Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement ofhydraulic conductivity in saturated and unsaturated soils.

Unit VII

Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

Unit VIII

Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management.

Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soiltemperature management.

Practical

Determination of B.D, P.D and mass volume relationship of soil, Mechanical analysis by hydrometer and international pipette method,

Measurement of Atterberg limits, Aggregate analysis - dry and wet, Measurement of soil-water content by different methods, Measurement of

soil-water potential by using tensiometer and gypsum Blocks,

Determination of soil-moisture characteristics curve and computation of pore-size, distribution, Determination of hydraulic conductivity under saturated and unsaturated conditions, Determination of infiltration rate of soil, Determination of aeration porosity and oxygen diffusion rate, Soil temperature measurements by different methods, Estimation of water balance components in bare and cropped fields.

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil physical properties and processes in relation to plant growth.

Suggested Reading

Baver LD, Gardner WH and Gardner WR. 1972. *Soil Physics*. John Wiley & Sons.
Ghildyal BP and Tripathi RP. 2001. *Soil Physics*. New Age International.
Hanks JR and Ashcroft GL. 1980. *Applied Soil Physics*. Springer Verlag.
Hillel D. 1972. *Optimizing the Soil Physical Environment toward Greater Crop Yields*. Academic Press.

SOIL- 502 Soil Fertility and Fertilizer Use (2+1) =03

Course Title	**: Soil Fertility and Fertilizer Use**
Course Code	**: Soil 502**
Credit Hours	**: 2+1**

Aim of the course

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

Theory

Unit I

Soil fertility and soil productivity; fertility status of major soils group of India; nutrient sources – fertilizers and manures; Criteria of essentiality, classification, law of minimum and maximum, essential plant nutrients - functions and deficiency symptoms, Nutrient uptake, nutrient interactions in soils and plants; long term effect of manures and fertilizers on soil fertility and crop productivity.

Unit II

Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation -types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

Unit III

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soil sand management under field conditions. Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

Unit IV

Sulphur - source, forms, fertilizers and their behavior in soils; roleincropsandhuman health; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers.

Unit (V)

Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chalets in nutrient availability.

Unit (VI)

Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions.

Unit (VII)

Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; specialty fertilizers concept, need and category.Currentstatusofspecialityfertilizersuseinsoilsandcropsofindia;

Unit ~~IX~~ (VIII)

Soil fertility evaluation - biological methods, soil, plant and tissue tests; soilquality in relation to sustainable agriculture, Determination of critical limit, DRIS

Unit (IX)

Definition and concepts of soil health and soil quality; Longterm effects of fertilizers and soil quality.

Practical

Soil and plant sampling and processing for chemical analysis

Determination of soil pH, total and organic carbon in soil

Chemical analysis of soil for total and available nutrients(major and micro)

Analysis of plants for essential elements(major and micro)

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning Out Comes :

Experience on the knowledge of soil fertility and fertilizers in relation to plant growth and

development.

Suggested Reading

Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.

Kabata-Pendias A and Pendias H. 1992. *Trace Elements in Soils and Plants*. CRC Press.

Kannaiyan S, Kumar K and Govindarajan K. 2004. *Biofertilizers Technology*. Scientific Publ.

Leigh J G. 2002. *Nitrogen Fixation at the Millennium*. Elsevier.

Mengel K and Kirkby EA. 1982. *Principles of Plant Nutrition*. International Potash Institute, Switzerland.

AGRON- 504 Principles and Practices of Water Management (2+1) = 03

Course Title : **Principles and Practices of Water Management**

Course Code : **Agron 504**

Credit Hours : **2+1**

IV Aim of the course

To teach the principles of water management and practices to enhance the water productivity

Theory

Unit I

Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in of India and concerned state, major irrigation projects, extent of area and crops irrigated in India and in different states.

Unit II

Field water cycle, water movement in soil and plants; transpiration; soil-water- plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Water availability and its relationship with nutrient availability and loses.

Unit III

Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and methods of irrigation; micro irrigation systems; deficit irrigation; fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.

Unit IV

Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency, Crop water requirement- estimation of ET and effective rainfall; Water management of the major crops and cropping systems. Automated irrigation system.

Unit V

Excess of soil water and plant growth; water management in problem soils, drainage requirement of crops and methods of field drainage, their layout and spacing; rain water management and its utilization for crop production.

Unit VI

Quality of irrigation water and management of saline water for irrigation, water management in problem soils

Unit VII

Soil moisture conservation, water harvesting, rain water management and its utilization for crop production.

Unit VIII

Hydroponics,

Unit IX

Water management of crops under climate change scenario.

Practical

Determination of Field capacity by field method
Determination of Permanent Wilting Point by sunflower pot culture technique
Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus
Determination of Hygroscopic Coefficient
Determination of maximum water holding capacity of soil
Measurement of matric potential using gauge and mercury type tensiometer
Determination of soil-moisture characteristics curves
Determination of saturated hydraulic conductivity by constant and falling head method

STAT-511 Experimental Designs (2+1) =03

Course Title : Experimental Designs
Course Code : STAT 511
Credit Hours : 2+1

Aim of the course

This course is meant for students of agricultural and animal sciences other than Agricultural Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

Unit I

Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.

Unit II

Uniformity trials, size and shape of plots and blocks, Analysis of variance, Completely randomized design, randomized block design and Latin square design.

Unit III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom. Concept of confounding.

Unit IV

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

Practical

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD, Analysis of factorial experiments, Analysis with missing data,
Split plot and strip plot designs.

Suggested Reading

Cochran WG and Cox GM. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
Dean AM and Voss D. 1999. *Design and Analysis of Experiments*. Springer.
Montgomery DC. 2012. *Design and Analysis of Experiments*, 8th Ed. John Wiley.

PGS 501: Library and Information Services **1(0+1)**

Objective:

PGS 501: Library and Information Services **1(0+1)**

Objective:

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical:

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources;

Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access, Catalogue and other computerized library services; Use of Internet including search enginesand its resources; ere sources access methods.

PGS 503 Intellectual Property and Its management in Agriculture 1(1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledgebased economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property ights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties

and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic

III[rd] Semester

SOIL- 503 **Soil Chemistry** (2+1) =03

Theory Course Title : Soil Chemistry

Course Code : Soil 503

Credit Hours : 2+1

Suggested Reading

To introduce the classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth.

Theory

Unit I

Chemical (elemental) composition of the earth's crust, soils, rocks and minerals

Unit II

Elements of equilibrium thermodynamics, chemical equilibrium, electrochemistry and chemical kinetics.

Unit III

Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil compqnents, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, Characterization of OM; clay-organic interactions.

Unit IV

Ion exchange processes in soil; cation exchange- theories based on law of massaction (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorptionisotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionicactivity measurement, thermodynamics, statistical mechanics; anion and ligand exchange–innersphere and outer-sphere surface complex formation, fixation of oxyanions,

hysteresisin sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition.

Unit V

Potassium, phosphate and ammonium fixation in soils covering specificand non- specific sorption; precipitation-dissolution equilibria; Conceptof quantity/intensity(Q/ I)relationship; step and constant-rate K; managementaspects.

Unit VI

Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity.

Unit VII

Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.

Unit VIII

Chemistry and electrochemistry of submerged soils, geochemistry of micronutrients, environmental soil chemistry

Practical

Preparation of saturation extract, measurement of pH, EC, CO, HCO, Ca, Mg, K and Na, Determination of CEC and AEC of soils, Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter andconductivity meter, Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method, Extraction of humic substances,

Potentiometric and conductometric titration of soil humic and fulvic acids, (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the D (E4/E6) values at two pH values, Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm, Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved. Determination of titratable acidity of an acid soil by BaCl2-TEA method, Determination of Q/I relationship of potassium, Determination of lime requirement of an acid soil by buffer method, Determinationof gypsum requirement of an alkali soil.

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of chemical behaviour of soil and their utility in research for solving field problem.

Suggested Reading

Bear RE. 1964. *Chemistry of the Soil.* Oxford and IBH.

Bolt GH and Bruggenwert MGM. 1978. *Soil Chemistry*. Elsevier.

Greenland DJ and Hayes MHB. 1981. *Chemistry of Soil Processes*. John Wiley & Sons.

Greenland DJ and Hayes MHB. *Chemistry of Soil Constituents*. John Wiley & Sons.

McBride MB. 1994. *Environmental Chemistry of Soils.* Oxford University Press.

Sposito G. 1981. *The Thermodynamics of Soil Solutions*. Oxford University Press.

Sposito G. 1984. *The Surface Chemistry of Soils*. Oxford University Press.

Sposito G. 1989. *The Chemistry of Soils*. Oxford University Press.

Stevenson FJ. 1994. *Humus Chemistry*. 2nd Ed. John Wiley & Sons.

Soil-505 **Soil Erosion and Conservation** 2+1=03

Course Title : **Soil Erosion and Conservation**

Course Code : **Soil 505**

Credit Hours : **2+1**

Aim of the course

To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water.

Theory Unit I

History, distribution, identification and description of soil erosion problems in India.

Unit II

Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity - estimation as EI30 index and kinetic energy; factors affectingwater erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation.

Unit III

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

Unit IV

Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout.

Unit V

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

Unit VI

Watershed management - concept, objectives and approach; water

harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds, sediment measurement

Practical

Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index

Computation of kinetic energy of falling rain drops

Computation of rainfall erosivity index (EI30) using rain gauge data

Land capability classification of a watershed

Visits to a watersheds

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil conservation and their utility in research for solving field problem.

Suggested Reading

Biswas TD and Narayanasamy G. (Eds.) 1996. *Soil Management in Relation to Land Degradation and Environment*. Bull. Indian Society of Soil Science No. 17.

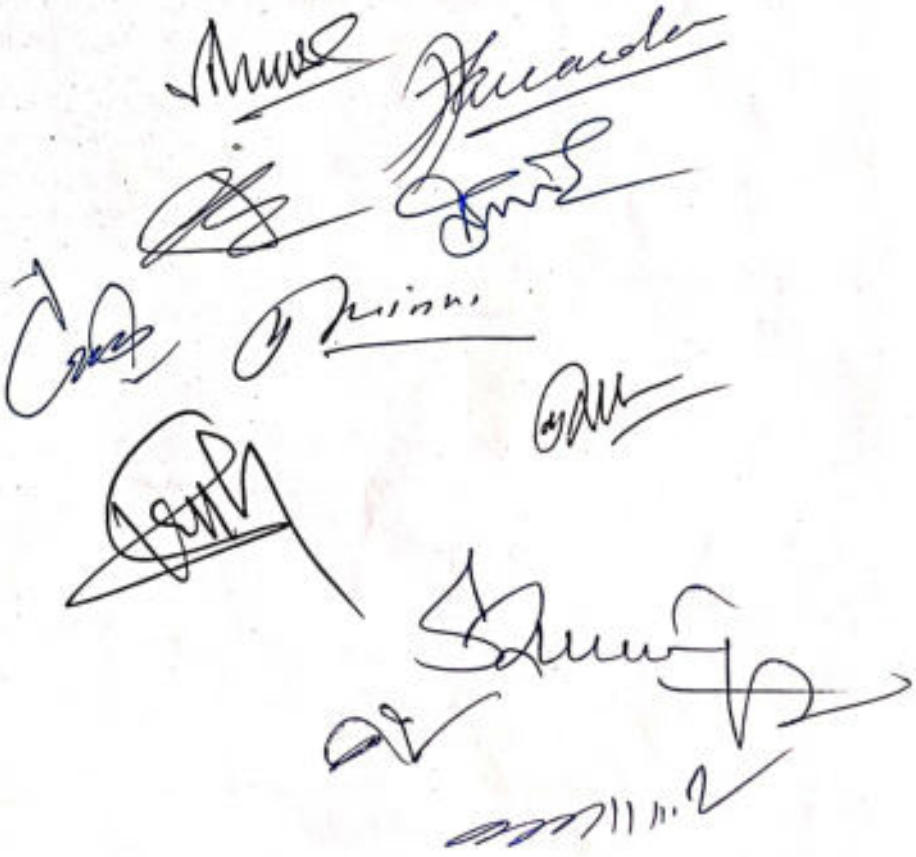
Doran JW and Jones AJ. 1996. *Methods of Assessing Soil Quality*. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.

Gurmal Singh, Venkataramanan C, Sastry G and Joshi BP. 1990. *Manual of Soil and Water Conservation Practices*. Oxford & IBH.

Hudson N. 1995. *Soil Conservation*. Iowa State University Press.

Indian Society of Soil Science 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.

Oswal MC. 1994. *Soil Physics*. Oxford & IBH.



(Minor) Principles and Practices of Organic Farming (2+1) = 03

I. **Course Title** : **Principles and Practices of Organic Farming**

II. **Course Code** : **AGRON 513**

III. **Credit Hours** : **2+1**

IV. **Aim of the course**

To study the principles and practices of organic farming for sustainable crop production.

V. **Theory**

Unit I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organics and farming standards; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.

Unit II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures, bio-fertilizers and biogas technology.

Unit III

Farming systems, selection of crops andcrop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, bio-pesticides.

Unit V

Socio-economic impacts; marketing and eXport potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

Method of making compost by aerobic method

Method of making compost by anaerobic method

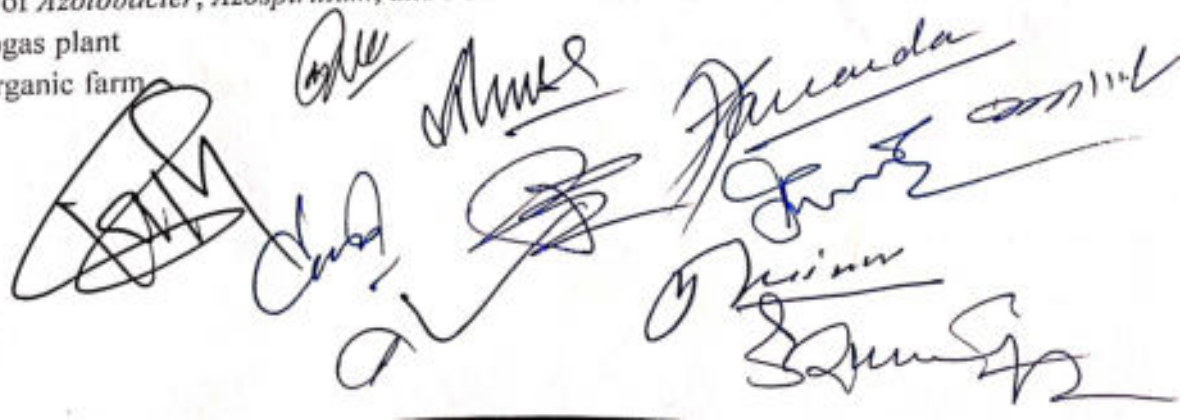
Method of making vermicompost

Identification and nursery raising of important agro-forestry tress and tress for shelter belts

Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field

Visit to a biogas plant

Visit to an organic farm



Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment. exposure visit of entrepreneurship on organic inputs

Learning outcome

Basic knowledge on organic farming for sustainable agriculture and development

Suggested Reading

Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.

Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.

Joshi M. 2016. *New Vistas of Organic Farming*. Scientific Publishers

Lampin N. 1990. *Organic Farming*. Press Books, Ipswitch, UK.

Palaniappan SP and Anandurai K. 1999. *Organic Farming – Theory and Practice*. Scientific Publ.

Rao BV Venkata. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic*

Environment and Legal Perspective: Publ.3, ParisaraprajnaParishtana, Bangalore.

Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.

Sharma A. 2002. *Hand Book of Organic Farming*. Agrobios.

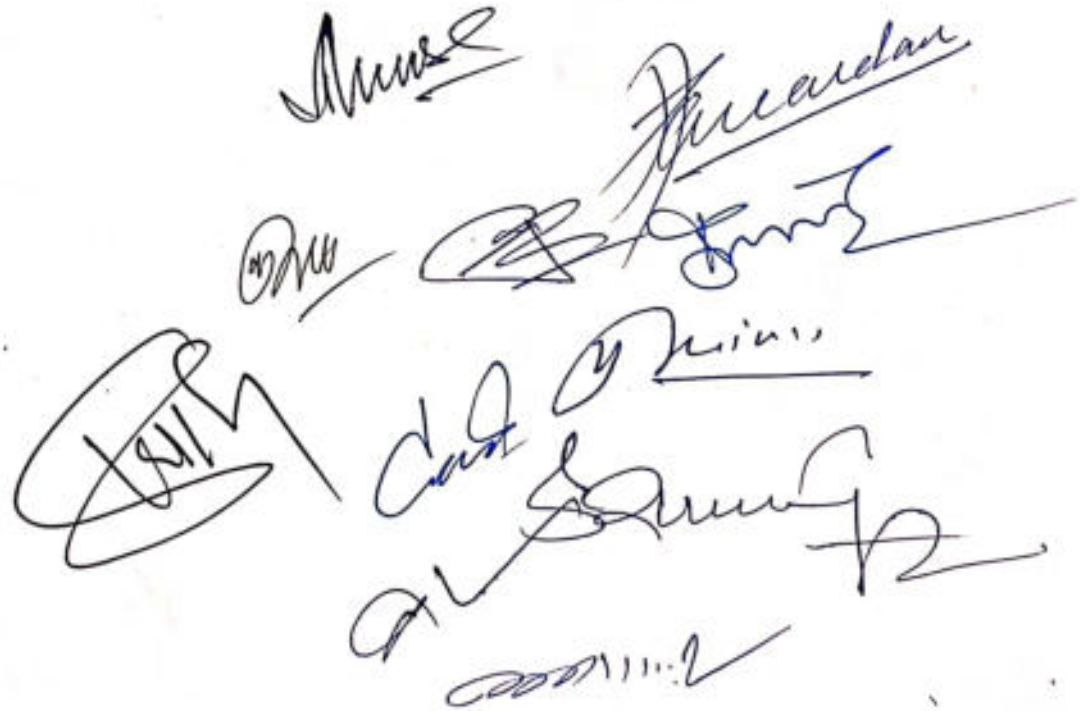
Singh SP. (Ed.). 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.

Subba Rao NS. 2002. *Soil Microbiology*. Oxford & IBH.

Trivedi RN. 1993. *A Text Book of Environmental Sciences*, Anmol Publ.

Veeresh GK, Shivashankar K and Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.

WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO.



PGS 505 Agricultural Research, Research Ethics And Rural Development Programmes (1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

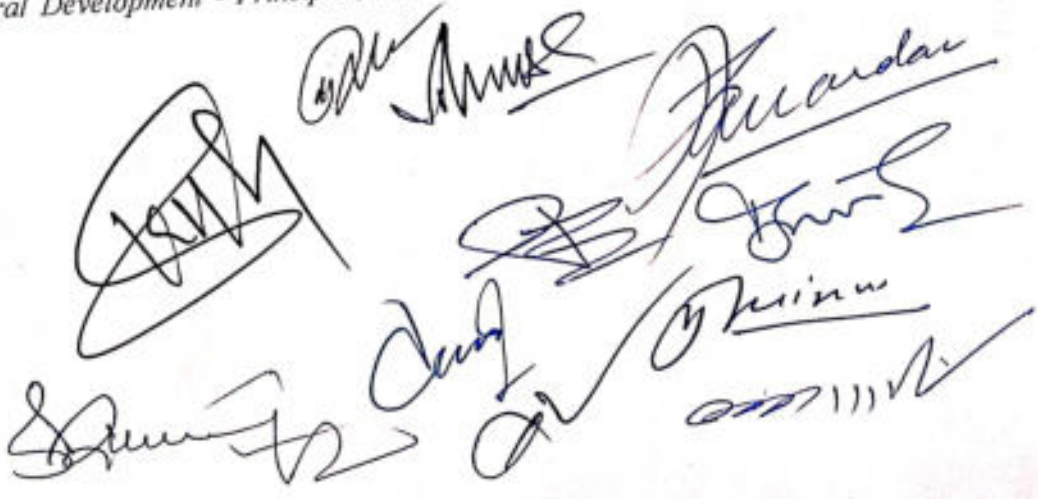
Suggested Readings

Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development.* Sage Publ.

Punia MS. *Manual on International Research and Research Ethics.* CCS Haryana Agricultural University, Hisar.

Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives.* Mittal Publ.

Singh K. 1998. *Rural Development - Principles, Policies and Management.* Sage Publ.



VIth Semester

SOIL- 510 ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS

(2+0) =02

I Course Title : Analytical Technique and Instrumental Methods in Soil and Plant Analysis

II Course Code : Soil 510

III Credit Hours : 0+2

I Aim of the course

To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

I. Practical

Unit I

Preparation of solutions for standard curves, indicators and standard solutions foracid-base, oXidation reduction and compleXometric titration; soil, water and plant sampling techniques, their processing and handling.

Unit II

Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.

Unit III

Principles of visible, ultra violet and infrared spectrophotometery, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry and X-ray defractrometery; identification of minerals by X-ray by different methods, CHNS analyzer.

Unit IV

Electrochemical titration of clays; estimation of eXchangeable cations (Na, Ca, Mg, K); estimation of root cation eXchange capacity.

Unit V

Wet digestion/fusion/eXtraction of soil with aquaregia with soil for elemental analysis; triacid/di-acid digestion of plant samples; determination of available and total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in soils; determination of total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in plants

Unit VI

Drawing normalized eXchange isotherms; measurement of redoX potential.

VI Teaching methods/activities

Classroom teaching and laboratory practicals

Vii-Learning Outcome Development of Confidence for setting soil testing laboratory

VIII Suggested Reading

Hesse P. 971. *Textbook of Soil Chemical Analysis*. William Clowes & Sons.

Jackson ML 1967. *Soil Chemical Analysis*. Prentice Hall of India.

Keith A Smith 1991. *Soil Analysis; Modern Instrumental Techniques*. Marcel Dekker.

Kenneth Helrich 1990. *Official Methods of Analysis*. Association of Official Analytical Chemists.

Page AL, Miller RH and Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison.

Piper CE. *Soil and Plant Analysis*. Hans Publ.

Singh D, Chhonkar PK and Pandey RN. 1999. *Soil Plant Water Analysis - A Methods Manual*.IARI, New Delhi.

Tan KH. 2003. *Soil Sampling, Preparation and Analysis*. CRC Press/Taylor & Francis.

Tandon HLS. 1993. *Methods of Analysis of Soils, Fertilizers and Waters*. FDCO, New Delhi.

Vogel AL. 1979. *A Textbook of Quantitative Inorganic Analysis*. ELBS Longman.

SOIL-512 Land Degradation & Restoration (1+0) = 01

Theory

I. Course Title : Land Degradation and Restoration

II. Course Code : Soil 512

III. Credit Hours : 1+0

I. Aim of the course

To impart knowledge related to various factors and processes of land degradationand their restoration techniques.

II. Theory

Unit I

Type, factors and processes of soil/land degradation and its impact on soil productivity including soil fauna, biodegradation and environment.

Unit II

Land restoration and conservation techniques-erosion control, reclamation of salt-affectedsoils; minelandreclamation, afforestation, organic products.

Unit III

Extent, diagnosis and mapping of land degradation by conventional and

RS-GIS tools; monitoring land degradation by fast assessment, modern tools, land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

III. Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

VI Learning outcome

Experience on restoration of degraded soil for optimization of crop yield

Biswas TD and Narayanasamy G. (Eds.). 1996. *Soil Management in Relation to Land Degradation and Environment*. Bull. Indian Soc. Soil Sci. 17, New Delhi.

Doran JW and Jones AJ. 1996. *Methods of Assessing Soil Quality*. Soil Science Society of America, Madison.

Greenland DJ and Szabolcs I. 1994. *Soil Resilience and Sustainable Land Use*. CABI.

Lal R, Blum WEH, Vailentine C and Stewart BA. 1997. *Methods for Assessment of Soil Degradation*. CRC Press.

Sehgal J and Abrol IP. 1994. *Soil Degradation in India - Status and Impact*. Oxford & IBH.

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